Promoting and maintaining healthy hydration in patients


Abstract
Fluid is essential for life and health. Nurses have an important role in helping patients maintain optimal levels of hydration, particularly in hospital or residential settings where access to fluid is less likely to be under the patient’s control. This article describes the benefits of healthy hydration, outlines guidelines on fluid requirements for different patient groups and discusses which beverages should be promoted. Myths about caffeine consumption and hydration will also be addressed using new clinical evidence.

Author
Carrie Ruxton
Freelance dietitian, Cupar, Fife.
Correspondence to: carrie@nutrition-communications.com

Keywords
Dehydration, fluid balance, fluid requirements and recommendations, health promotion, hydration

Aims and intended learning outcomes
The aim of this article is to highlight the benefits of healthy hydration and how this can be promoted effectively in different patient groups. After reading this article and completing the time out activities you should be able to:

- Identify the signs of dehydration and understand its detrimental effect on health.
- Describe factors that influence fluid requirements.
- Access and use guidelines on fluid requirements in different patient groups.
- Recommend appropriate beverages to patients and help them achieve optimal hydration.
- Understand evidence supporting the role of caffeinated beverages in maintaining hydration.

Introduction
Water is essential for human life and accounts for 50-75% of body weight, depending on the person’s age (Jéquier and Constant 2010). Water has many roles in the body, including regulating temperature, lubricating the lungs and skin, controlling blood pressure, and transporting nutrients, oxygen and waste (Jéquier and Constant 2010).

Even mild dehydration can have a negative effect on health, including mental and physical performance (Ritz and Berrut 2005, Shirreffs 2005). In hospitalised patients, evidence shows that good hydration can assist in the management of diabetes and help prevent pressure ulcers; constipation; urinary tract infections and incontinence; kidney stones;
heart disease; low blood pressure; cognitive impairment; falls and poor oral health (Manz 2007, Scales and Pilsworth 2008). The importance of good hydration has been recognised in a number of policy documents (NHS Quality Improvement Scotland 2003, Department of Health 2007) and resources (British Dietetic Association (BDA) 2007, Royal College of Nursing and National Patient Safety Association (RCN and NPSA) 2007) aimed at improving the provision of fluids for patients as part of their therapeutic care. Nurses and other healthcare professionals have a key role in helping patients to achieve and maintain adequate fluid balance.

This article examines the benefits of healthy hydration, outlines guidelines on fluid requirements in different patient groups and discusses how nurses can help to meet these requirements using appropriate beverages.

**Fluid balance**

Fluid balance is the homeostatic control of fluid in the body. In healthy people, body water levels are tightly regulated within an optimal range by a complex system involving hormones, and changes to kidney function and thirst sensations (Scales and Pilsworth 2008). When body water levels become too low (or the concentration of electrolytes in the blood is too high), small changes in plasma osmolarity are detected by the brain, which stimulates production of antidiuretic hormone and aldosterone (Benelam and Wyness 2010). These hormones promote thirst and conserve water in the kidneys (less urine is excreted and more sodium and water are re-absorbed). However, fluid balance is only maintained for a short time. While humans can survive several weeks without food, a lack of water will result in death after only three to five days, and even less time in hot or dry environments (Benelam and Wyness 2010).

As shown in Box 1, the average adult consumes around 2,200mL of fluid per day from food and drinks (Vander et al 1994). Some body water is also recycled (350mL), making the total water gain 2,550mL (Vander et al 1994). A similar amount of water is lost through urine and insensible losses as a result of respiration, sweat, faeces and evaporation, assuming a temperate climate and limited physical activity.

There is no universally accepted test for assessing hydration status, but several methods can be used individually, or in combination (Armstrong 2007) (Box 2). Some methods are precise and involve invasive techniques, making them more suitable for research or clinical environments. Others are less invasive (but also less precise) and are therefore useful for public health or home environments.

Normal hydration exists when water losses are replaced by fluid consumption, whereas dehydration is defined as a 1% or greater loss of body weight as a result of fluid loss (Kleiner 1999). Under normal circumstances, fluid balance is regulated within 0.2% of body weight over a 24-hour period (Grandjean and Campbell 2004). Dehydration can be further defined into three categories (Benelam and Wyness 2010):

- Mild (1-2% loss of body weight).
- Moderate (5% loss of body weight).
- Severe (10% loss of body weight).

Complete time out activity 1

**Box 1**

**Fluid balance equation**

**Water gain:**
- Drinks = 1,200mL
- Food = 1,000mL
- Metabolic water = 350mL
  
  Total = 2,550mL

**Water loss:**
- Skin and lungs = 900mL
- Sweat = 50mL
- Faeces = 100mL
- Urine = 1,500mL

  Total = 2,550mL

**Box 2**

**Methods for assessing hydration status**

**Less invasive methods:**
- Urine colour charts.
- Urine volume (compared with fluid consumption).
- Thirst (although this is an unreliable method as it is insensitive to small changes in body water).
- Fluid balance records and food charts.
- Changes in body weight.
- Urine specific gravity or osmolality.
- Saliva osmolality or total protein concentration in saliva.

**More invasive methods:**
- Blood osmolality.
- Plasma urea, electrolytes and total protein.
- Stable isotope dilution.
- Neutron activation analysis.
- Central venous pressure measurement.

(Adapted from WaterUK 2006, Armstrong et al 2007)
Various factors influence hydration and these are shown in Box 3.

Complete time out activity 2

Consequences of dehydration
Symptoms of dehydration include lethargy, headaches, dizziness, confusion and thirst. Urine also changes colour from a pale, straw yellow to dark yellow or even brown. Reduction in body weight can also be detected even if dehydration is mild (European Food Safety Authority Panel on Dietetic Products, Nutrition, and Allergies (EFSA) 2010). Clinical signs of dehydration include low blood pressure, tachycardia, a weak ‘thready’ pulse, cool peripheries (hands and feet) and oliguria (Scales and Pilsworth 2008) (Box 4). However, by the time these changes are detected, the body will already be moderately dehydrated.

The extent of the signs, symptoms and consequences of dehydration depend on the level of fluid deficit. While severe dehydration (10% loss of body weight) is life threatening, even a fluid loss equivalent to 1-2% of body weight can have an adverse affect on physical and mental performance (Jéquier and Constant 2010). Therefore it is important that nurses assess patients for early signs of dehydration, for example by using food and fluid charts. The consequences of mild to moderate dehydration are described in more detail below.

Mental performance
As the brain is 75% water (Jéquier and Constant 2010), it is unsurprising that mental performance can be affected even by mild dehydration. Studies show that a lack of adequate fluid intake reduces concentration and alertness, and adversely affects ability to perform mental tasks (Ritz and Berrut 2005). Mood can be depressed (D’anci et al 2009) and aggression can also be heightened by dehydration (Hall and Lane 2001).

Physical performance
Elite athletes take hydration seriously as it is recognised that dehydration adversely affects sporting performance. Not only are speed, endurance and recovery affected, but feelings of fatigue are heightened making it more difficult to maintain effort (Shirreffs 2005). If not closely monitored, dehydration can cause a rise in body temperature and even physical collapse (Kenefick and Sawka 2007).

Urinary tract health
Dehydration can increase the risk of urinary tract infections, particularly in women and older people (RCN and NPSA 2007). This is because regular urination keeps the lower urinary tract free from bacteria (Manz 2007). Therefore, adequate fluid intake can help to prevent or manage such infections.

Constipation
In conjunction with dietary fibre, sufficient fluid is needed to bulk up and make it easy to pass faecal matter. Chronic constipation is a common problem in older people and young children and is linked to inadequate fluid consumption (Arnaud 2003). The use of saline laxatives, such as magnesium hydroxide (milk of magnesia) to treat constipation can exacerbate dehydration if fluid replacement is not maintained. This can also reduce the efficacy of treatment (Arnaud 2003).

BOX 3
Factors influencing hydration
- Fever.
- Diarrhoea, vomiting and bowel disorders.
- Polyuria (for example, as a result of diabetes).
- Nasogastric drainage.
- Burns.
- Medications (for example, diuretics, antihistamines and antipsychotic drugs).
- Blunting of the thirst mechanism (for example, as a result of age, altered consciousness or mental health problems).
- Nil by mouth.
- Prolonged exercise.
- Alcohol consumption.
- Hot or humid environments.
(Adapted from Scales and Pilsworth 2008, Maughan and Shirreffs 2010)

BOX 4
Signs and symptoms of dehydration
- Lethargy, headache, dizziness, thirst, dry mouth or confusion.
- Urine becoming darker in colour from pale, straw yellow to dark yellow or brown.
- Acute loss of body weight of 1% or more.
- Low blood pressure, tachycardia, increased respiration, a weak ‘thready’ pulse, cool hands and feet, oliguria and increased core body temperature.
(Adapted from Scales and Pilsworth 2008)
Fluid recommendations
Dietary reference intakes for total water have been published (EFSA 2010). These include fluid from foods, for example soup, fruits, vegetables and dairy products, as well as from drinks (Table 1). Assuming that 30% of fluid intake is provided by foods (EFSA 2010) and that one glass or cup contains 250mL, fluid recommendations translate to around four cups a day for younger children, five to six cups a day for older children and adult women, and seven cups a day for adult men.

Fluid guidelines have also been published by the Institute of Medicine (2005) and the World Health Organization (WHO) (2005). These differ slightly from the EFSA (2010) dietary reference intakes in that recommended intake for adults are 200-1000mL higher, while recommendations for lactating women are 1-2L higher.

It is worth remembering that fluid recommendations only give a guide for groups of people. Individual requirements will vary as a result of differences in ambient temperature and humidity, physical activity levels, age and health status (for example, illness, pregnancy or lactation).

At-risk groups
Anyone can become mildly dehydrated once voluntary fluid intake fails to meet individual needs. Busy working lives, travel and a lack of suitable beverages can alter usual drinking habits, while ambient temperature and exercise can increase fluid requirements. As thirst normally becomes noticeable only when 1-2% of body water has been lost (Benelam and Wyness 2010), maintaining optimal hydration depends on regular fluid consumption regardless of the degree of thirst. Some individuals are at particular risk of dehydration as discussed.

Physically active people
Fluid requirements increase when exercise is performed, with higher intensity sports of a prolonged nature having the highest requirements (Maughan and Shirreffs 2010). This is because exercise increases body temperature and stimulates diaphoresis (sweating). The need for fluid is even greater if exercise is performed in a warm or humid environment. People engaged in physical activity should drink water regularly. However, those undertaking intense or prolonged exercise (longer than 40 minutes) will also need to replenish sodium and glucose by using isotonic sports drinks (Benelam and Wyness 2010).

Older people
Older people are at risk of dehydration because of reduced thirst sensations and age-related changes to the kidneys, which effect the body’s ability to cope with dehydration (EFSA 2010). Fear of incontinence, swallowing problems and reduced access to fluids in the care environment can lead to inadequate fluid intake (Jéquier and Constant 2010). Signs of dehydration may include dry mouth and tongue, raised pulse, cool peripheries and low urine output (Scales and Pilsworth 2008). Older people should be encouraged to drink regularly while being reassured, if necessary, about continence issues. Older people tend to drink a lot of tea (Henderson et al 2003), but as tea counts towards overall fluid requirements (BDA 2007), there is generally no need to limit consumption.

Inpatients
Certain groups of inpatients are at particular risk of dehydration, for example those with high fluid requirements (as a result of fever or disease), those who are nil by mouth.

Complete time out activity 3

At-risk groups activity 2
Describe potential physical and mental consequences of dehydration.

At-risk groups activity 3
Which patient groups are at increased risk of dehydration? List two reasons for each group and suggest any measures that could be taken to reduce the risk of dehydration in these patients.

### TABLE 1

<table>
<thead>
<tr>
<th></th>
<th>Adequate intake of fluid (mL/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From food*</td>
</tr>
<tr>
<td></td>
<td>From drinks†</td>
</tr>
<tr>
<td></td>
<td>Total fluid</td>
</tr>
<tr>
<td><strong>Males</strong></td>
<td></td>
</tr>
<tr>
<td>2-3 years</td>
<td>390</td>
</tr>
<tr>
<td>2-3 years</td>
<td>910</td>
</tr>
<tr>
<td>2-3 years</td>
<td>1,300</td>
</tr>
<tr>
<td>4-8 years</td>
<td>480</td>
</tr>
<tr>
<td>4-8 years</td>
<td>1,120</td>
</tr>
<tr>
<td>4-8 years</td>
<td>1,600</td>
</tr>
<tr>
<td>9-13 years</td>
<td>630</td>
</tr>
<tr>
<td>9-13 years</td>
<td>1,470</td>
</tr>
<tr>
<td>9-13 years</td>
<td>2,100</td>
</tr>
<tr>
<td>14 years +</td>
<td>750</td>
</tr>
<tr>
<td>14 years +</td>
<td>1,750</td>
</tr>
<tr>
<td>14 years +</td>
<td>2,500</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
</tr>
<tr>
<td>2-3 years</td>
<td>390</td>
</tr>
<tr>
<td>2-3 years</td>
<td>910</td>
</tr>
<tr>
<td>2-3 years</td>
<td>1,300</td>
</tr>
<tr>
<td>4-8 years</td>
<td>480</td>
</tr>
<tr>
<td>4-8 years</td>
<td>1,120</td>
</tr>
<tr>
<td>4-8 years</td>
<td>1,600</td>
</tr>
<tr>
<td>9-13 years</td>
<td>570</td>
</tr>
<tr>
<td>9-13 years</td>
<td>1,330</td>
</tr>
<tr>
<td>9-13 years</td>
<td>1,900</td>
</tr>
<tr>
<td>14 years +</td>
<td>600</td>
</tr>
<tr>
<td>14 years +</td>
<td>1,400</td>
</tr>
<tr>
<td>14 years +</td>
<td>2,000</td>
</tr>
<tr>
<td>Pregnant</td>
<td>690</td>
</tr>
<tr>
<td>Pregnant</td>
<td>1,610</td>
</tr>
<tr>
<td>Pregnant</td>
<td>2,300</td>
</tr>
<tr>
<td>Lactating</td>
<td>810</td>
</tr>
<tr>
<td>Lactating</td>
<td>1,890</td>
</tr>
<tr>
<td>Lactating</td>
<td>2,700</td>
</tr>
</tbody>
</table>

* Estimated assuming 30% of fluid intake from food
† Calculated as the difference between total fluid and fluid from food (European Food Safety Authority Panel on Dietetic Products, Nutrition, and Allergies 2010)
individuals who cannot swallow (as a result of stroke or disability) or those who are unconscious. In cases where the oral route cannot be used to deliver fluids, non-oral routes will need to be considered. These include enteral feeding and subcutaneous or intravenous routes.

**Infants and children**

The infant body is about 75% water, and a high metabolic rate combined with a high surface-to-body-weight ratio makes babies vulnerable to changes in ambient temperature (Gorelick et al 1997). Infants consume 10-15% of their body weight as water compared with only 2-4% in adults, therefore infants’ fluid requirements per unit body weight are higher than in adults (EFSA 2010). Infants are also less able to communicate thirst, while their kidneys are not sufficiently developed to cope with fluid imbalances (Jéquier and Constant 2010). Dehydration is a serious condition for infants and young children (EFSA 2010). Low intake of fluid can also result in constipation (Coughlin 2003).

Breast feeding on demand is the best way to satisfy infant fluid requirements (WHO 2012). For young children, it helps if parents and carers make healthy fluids, such as water and milk available. Carbonated and sugar-sweetened soft drinks should be kept to a minimum because of the risk of caries and dental erosion (Popkin et al 2006). Fruit juices, which are also acidic, can be offered at mealtimes (to minimise risk of dental erosion). There is no agreement on the age from which children can consume caffeinated drinks.

However, to maximise iron absorption from foods, if caffeinated drinks are consumed, it is best to offer weak unsweetened versions, between meals (BDA 2007). Strong caffeinated drinks, such as brewed coffee or energy drinks, are likely to contain too much caffeine for children to consume caffeinated drinks.

**Caffeinated beverages**

Media articles and healthcare professional leaflets sometimes claim that caffeinated drinks, such as tea and coffee, have an adverse affect on normal hydration. For example, the RCN and NPSA (2007) hydration toolkit suggests that caffeinated drinks increase urine output and that patients should ask for a glass of tap water to drink with their coffee and tea in cafes or restaurants. However, the view that typical intake of caffeine can impair hydration is not supported by the literature (BDA 2007).

Various studies have examined how caffeine pills or caffeinated drinks affect hydration. A review of the literature reported that a large caffeine bolus (250-500mg) could cause mild dehydration, but that caffeine intakes of 38-400mg spread throughout the day are well tolerated (Ruxton 2008). This equates to a daily maximum of eight cups of tea or four cups of brewed coffee, as one cup of tea contains approximately 50mg of caffeine, while one cup of coffee contains around 100mg of caffeine (Ruxton 2008). Another study found that caffeinated beverages appear to have no diuretic action (Maughan and Griffin 2003). Reasons to support this were that the modest amounts of caffeine found in tea and coffee were too low to cause dehydration, and consumers of caffeinated beverages develop tolerance to caffeine over time.

A randomised controlled crossover trial looked at the effect of black (regular) tea consumption on hydration (Ruxton and Hart 2011). Twenty one males consumed either four cups of tea or six cups of tea with identical amounts of water as the control (representing a total fluid intake of 1,350mL per day). Each participant took part in both the tea and water study conditions to reduce the risk of bias. Depending on the condition, the caffeine intake was 0mg, 168mg or 252mg per day. Bloods were taken regularly over a 12-hour period, while urine was collected for 24 hours. Foods and other drinks were controlled during the trial. Results showed no significant differences between tea and water for any of the hydration markers, for example total urine volume, blood osmolality, electrolytes and urea. This suggests that drinking up to six cups of tea per day, has similar hydrating properties to water. The average intake of tea in the UK is two to three cups per day, so most tea drinkers are within the six cups per day range.

These results are supported by other studies. A two-day intervention, carried out at altitude, reported no differences in 24-hour urine output or hydration measures when participants drank tea or water (Scott et al 2004). In a randomised, controlled crossover trial in 18 sedentary adults, the effect of water, cola and coffee on hydration was compared over a 24-hour period (Grandjean et al 2000). No significant differences were found between the different drinks for any markers of hydration. Caffeine intakes ranged from 114-253mg. Fiala et al (2004) tested ad libitum caffeinated versus...
non-cafffeinated cola over three days using a randomised crossover design. During the trial, the ten participants were physically active for four hours a day. Apart from a significant difference in the colour of urine, there were no differences in urine or blood measures of hydration. The average daily caffeine intake in the caffeinated condition was 245mg.

It is worth noting that tea is a natural source of flavonoids, which may offer heart health benefits as such a reduced risk of myocardial infarction and possibly lower cholesterol levels (Hodgson and Croft 2010), while the caffeine and L-theanine content may benefit cognitive function (Bryan 2008).

Promoting the right fluids
While all non-alcoholic fluids count towards fluid requirements, some beverages are healthier than others. The British Nutrition Foundation recently produced a fluid guide which ranked water first among suitable beverages for topping up fluid levels, closely followed by unsweetened tea, coffee and herbal infusions (Benelam and Wyness 2010). In addition, a beverage guidance system was proposed by a group of scientists from the United States (Popkin et al 2006), which ranked all beverages on a scale of one to six based on calorie and nutritional composition, and related health benefits versus risks. Water was given the highest rating of one, while unsweetened tea, coffee and herbal infusions were all given a rating of two. However, in this category, up to eight cups of tea were recommended per day in comparison with only four cups of coffee (this is because of the higher caffeine levels in coffee). Sugar-sweetened soft drinks had the lowest rating of six (Popkin et al 2006). A leaflet published by the BDA (2007) suggested that suitable beverages may include water, diluted fruit juice, and herbal and fruit teas.

Advice on optimal hydration includes:
- Drink regularly throughout the day, aiming for five to seven cups of fluid in addition to food (EFSA 2010).
- Remember that foods, such as soup, stews, fruit, vegetables and yogurt contribute to fluid intake (EFSA 2010).
- Keep alcoholic drinks to a minimum (Benelam and Wyness 2010), especially when the risk of dehydration is high, for example when travelling, exercising or in hot environments.

Reference

TIME OUT

Estimate your own fluid intake for one day from the food and drinks you consume. Compare this with the fluid recommendations in Table 1. Comment on your findings, particularly in regard to the healthiness of the drinks consumed.

Contrary to popular belief, typical intakes of caffeinated drinks are not dehydrating. Discuss evidence to support this with one of your colleagues.
Drinks should be offered to young children and older people on a regular basis as they may dehydrate quickly. Breast-feeding on demand is the best way to satisfy fluid requirements in infants (WHO 2012).

Drinking up to six cups of tea per day is as hydrating as consuming an identical volume of water (Ruxton and Hart 2011). Studies show that typical intake of caffeinated drinks, providing up to 400mg of caffeine per day, are not dehydrating (Ruxton 2008).

Vary the types of fluids consumed over the day in line with healthy beverage recommendations (Popkin et al 2006). Nurses working with inpatients can help to promote good hydration by ensuring that foods and fluids are accessible, prompting individuals to drink regularly, educating patients and carers about the benefits of good hydration, and offering fluids that are enjoyed by patients, where possible.

Conclusion
Achieving and maintaining optimal hydration is vital for health, recovery, and physical and mental performance. Nurses have a key role in recognising early signs of poor hydration and advising patients on appropriate strategies to prevent dehydration. Good practice includes identification of patients who may be at risk of dehydration, consistent monitoring of fluid balance and early signs of dehydration, and adopting strategies to ensure that patients have regular access to healthy beverages.

Competing interests
Carrie Ruxton is a member of the Tea Advisory Panel, which advises the UK Tea Council. For more information, see www.teaadvisorypanel.com or telephone 020 7705 8989.

Now that you have completed the article, you might like to write a practice profile. Guidelines to help you are on page 60.